

What Is Claimed Is:

1. A display system, comprising:  
at least one light emitting material having an absorption band carried  
5 on a support, wherein the support is a laminated article having a first ply and  
a second ply; and  
a projection assembly having an electromagnetic radiation source, the  
projection assembly configured to direct radiation of one or more selected  
wavelengths within the absorption band of the light emitting material toward  
10 the light emitting material to cause at least a portion of the light emitting  
material to emit light.
2. The system according to claim 1, wherein the light emitting  
material is located between the first and second plies.  
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3. The system according to claim 3, including a functional coating  
located on the support.
4. The system according to claim 1, wherein at least one of the  
20 first and second plies is selected from glass, plastic, and ceramic.
5. The system according to claim 1, including an interlayer  
located between the first and second plies, with the light emitting material located  
between the first ply and the interlayer.  
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6. The system according to claim 1, wherein the support is an  
automotive transparency.
7. The system according to claim 6, wherein the support is a  
30 windshield.
8. The system according to claim 1, wherein the projection  
assembly is controlled to cause the light emitting material to form an image.

9. The system according to claim 1, wherein the support has a first portion that is substantially transparent to the one or more selected wavelengths and a second portion that is substantially non-transparent to the one or more selected wavelengths.

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10. The system according to claim 1, wherein the electromagnetic radiation source includes a laser or laser diode.

11. The system according to claim 1, wherein the radiation is in the range of 300 nanometers to 410 nanometers.

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12. The system according to claim 1, wherein the projection assembly includes a controller configured to selectively direct the radiation toward one or more selected areas of the light emitting material.

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13. The system according to claim 1, wherein the projection assembly includes a directing system configured to direct the radiation from the radiation source toward the light emitting material.

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14. The system according to claim 12, wherein the directing system comprises at least one mirror.

15. The system according to claim 12, wherein the directing system includes a movement device configured to direct the radiation toward at least a selected area of the light emitting material.

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16. The system according to claim 1, wherein the light emitting material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

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17. The system according to claim 1, wherein the support is a component of an article selected from a commercial window, a residential window, a commercial sign, an advertising display, and an insulating glass unit.

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18. A display system, comprising:

at least one light emitting material having an absorption band carried on a automotive transparency; and

a projection assembly having an electromagnetic radiation source, the projection assembly configured to direct radiation of one or more selected wavelengths within the absorption band of the light emitting material toward the light emitting material to cause at least a portion of the light emitting material to emit light.

19. The system according to claim 18, wherein at least one of the first and second plies is selected from annealed glass, tempered glass, and heat strengthened glass.

20. The system according to claim 19, including a functional coating located between the second ply and the interlayer.

21. The system according to claim 19, wherein the interlayer is selected from polyvinyl butyral, plasticized polyvinyl chloride, and polyethylene terephthalate.

22. The system according to claim 20, wherein the support is a monolithic article.

23. The system according to claim 20, wherein the automotive transparency is a windshield.

24. The system according to claim 20, wherein the light emitting material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

25. A head-up display system, comprising:  
at least one light emitting material having an absorption band carried on a support; and  
a projection assembly having an electromagnetic radiation source, the projection assembly configured to direct radiation of one or more selected wavelengths within the absorption band of the light emitting material toward

the light emitting material to cause at least a portion of the light emitting material to emit light.

26. The system according to claim 25, wherein the light emitting  
5 material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

27. A vehicle head-up display, comprising:  
a windshield having a first ply and a second ply;  
10 at least one light emitting material having an adsorption band and located between the first and second ply; and  
a projection assembly having an electromagnetic radiation source and configured to direct radiation of one or more selected wavelengths within the absorption band toward the light emitting material to cause at least a portion  
15 of the light emitting material to emit light to form an image.

28. A vehicle having a head-up display according to claim 27.

29. The display according to claim 27, wherein the light emitting  
20 material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

30. A method of displaying images, comprising the steps of:  
providing a support having at least one light emitting material;  
25 directing electromagnetic radiation from a radiation source in a first direction along a first scan path while selectively energizing and deenergizing the radiation source;  
displacing the electromagnetic radiation in a second direction substantially perpendicular to the first direction; and  
30 directing the electromagnetic radiation in a third direction along a second scan path substantially parallel to the first direction while selectively energizing and deenergizing the radiation source, wherein energizing and de-energizing the radiation source along the scan paths forms an image.

31. The method according to claim 30, including energizing and deenergizing the radiation source to form adjacent light emitting and non-light emitting areas on the support.

5 32. The method according to claim 30, including blocking and unblocking radiation from the radiation source to form adjacent light emitting and non-light emitting areas on the support.

33. The method according to claim 30, wherein the light emitting  
10 material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

34. A method of displaying images, comprising the steps of:  
selectively directing electromagnetic radiation from a radiation source  
15 towards an automotive transparency having at least one light emitting material; and  
moving the radiation along at least a portion of the automotive  
transparency and controlling the radiation source to cause the light emitting  
material to emit light to form an image.

20 35. The method according to claim 34, wherein the light emitting material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

36. A display system, comprising:  
25 a sheet having at least one light emitting material having a predetermined absorption band and having a major surface defined as a first major surface and a major surface opposite to and spaced from the first major surface defined as a second major surface;  
a layer substantially non-transparent to wavelengths within the  
30 predetermined absorption band over a portion of the second major surface;  
and  
a projection assembly having an electromagnetic radiation source for  
generating at least one beam having at least one selective wavelength within  
the absorption band, the projection assembly including a movement device  
35 configured to direct the beam toward the first major surface to impinge the

beam on the light emitting material and to move the beam over the surface of the light emitting material to cause at least a portion of the light emitting material to emit wavelengths at least in the range of 380 nanometers to 760 nanometers of the electromagnetic spectrum defined as the visible region.

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37. The display system according to claim 36, wherein the light emitting material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

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38. The display system according to claim 36, wherein the radiation source is selected from lasers capable of generating one radiation beam, a UV light generating source, electron guns, LEDs, lasers capable of generating two radiation beams of different wavelengths, laser diodes and combinations thereof.

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39. The display system according to claim 38, wherein the radiation source emits energy having a wavelength selected from greater than 0 to 400 nanometers of the electromagnetic spectrum, and the light emitting material emits energy having a wavelength in the range of 400 nanometers to 700 nanometers of the electromagnetic spectrum.

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40. The display system according to claim 36, wherein the light emitting material is a dye-doped dendrimer.

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41. The display system according to claim 36, wherein the light emitting material is selected from a layer of fluorescent material on the first major surface of the sheet and a fluorescent material in body of the sheet, the body of the sheet defined by and includes the first and second major surfaces of the sheet.

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42. The display system according to claim 36, wherein the sheet is a first ply and the layer is a second ply overlaying selected portions of and adhered to the first surface of the first ply.

43. The display system according to claim 36, wherein the sheet is a first ply and the layer is an interlayer overlaying and adhered to the second

surface of the first ply and further including a second ply adhered to the interlayer to provide a laminated article, wherein the light emitting material is between the first ply and the interlayer.

5                   44.     The display system according to claim 43, wherein the display system is a head-up display and the laminated article is an automotive transparency.

                  45.     The display system according to claim 36, wherein the sheet is a component of an article selected from a commercial window, a residential window,  
10   a commercial sign, an advertising display, and an insulating glass unit.

                  46.     A laminated article for use in displaying images, comprising:  
                  a first transparent sheet having a first major surface and an opposite major surface defined as a second major surface;  
15               a second sheet having a first major surface and an opposite major surface defined as a second major surface;  
                  an interlayer between and securing the second surface of the first and second sheets to position the first and second sheets in facing relationship to one another, and  
20               at least one light emitting material having an absorption band on the first major surface of the first sheet or between the second major surfaces of the first and second sheets wherein the at least one light emitting material emits wavelengths in the range of 380 to 760 nanometers of the electromagnetic spectrum when radiation of one or more selected  
25               wavelengths within the absorption band of the light emitting material impinges on the at least one light emitting material.

                  47.     The laminated article according to claim 46 wherein the light emitting material is selected from organic light materials, organo-metallic light  
30   materials, inorganic light emitting materials and mixtures thereof.

                  48.     The laminated article according to claim 46 wherein the light emitting material is selected from oxides, sulfides, or oxide-sulfides of metals that are "doped" with material selected from  $Y_2O_3:Eu$ ,  $YVO_4:Tm$ ,  $ZnS:Mn$ ,  $Y_2O_2S:Pr$ , and  
35    $Gd_2O_2S:Tb$ ,  $Lu_2SiO_5:Ce$ ,  $Y_2SiO_5:Ce$ , and  $GdSiO_5:Ce$ ; yttrium and gadolinium silicates

activated by rare earths elements, luminophors activated by  $2Y_2O_3 \cdot SiO_2$ ,  $Y_2SiO_5$ ,  $Y_{4.67} \cdot (SiO_4)_3O$ , and  $Y_2Si_2O_7$  prepared from pure Si and  $Y_2O_3$  by fusion,  $2Gd_2O_3 \cdot SiO_2$ -Th,  $Gd_2O_3 \cdot I_3SiO_2$ -Ce,  $Gd_2O_3 \cdot 3SiO_2$ -Eu and mixtures thereof.

5        49.     The laminated article according to claim 46 wherein the second sheet is a transparent sheet.

10        50.     The laminated article according to claim 46 further including:  
a member non-transparent to wavelengths within the predetermined absorption band between the at least one light emitting material and the first major surface of the second sheet.

15        51.     The laminated article according to claim 46, wherein the laminated article is an automotive transparency.

20        52.     The laminated article according to claim 46, wherein the light emitting material is a fluorescent material and the fluorescent material is between the first sheet and the interlayer.

25        53.     The laminate article according to claim 46, wherein the light emitting material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

30        54.     The laminated article according to claim 46 wherein the light emitting material is a dye-doped dendrimer.

35        55.     A laminated article for use in displaying objects, comprising:  
a first transparent sheet having a first major surface and an opposite major surface defined as a second major surface;  
a second sheet having a first major surface and an opposite major surface defined as a second major surface;  
an interlayer between and securing the second surface of the first and second sheets in facing relationship to one another, and  
at least one light emitting material capable of Up-Conversion of infrared energy into visible radiation defined as Up-Conversion material on



the first major surface of the first sheet or between the first major surfaces of the first and second sheets.

56. The laminated article according to claim 55 wherein the  
5 second sheet is a transparent sheet.

57. The laminated article according to claim 55 wherein the  
Up-Conversion material is between the first major surface of the first and second  
sheets.  
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58. The laminated article according to claim 55, wherein the  
laminated article is an automotive transparency.

59. The laminated article according to claim 55, wherein the  
15 Up-Conversion material is a dye-doped dendrimer.

60. The laminated article according to claim 55, wherein the  
Up-Conversion material includes dopants selected from  $\text{Tm}^{3+}$ ,  $\text{Er}^{3+}$ ,  $\text{Tm}^{3+}\text{-Yb}^{3+}$ ,  
 $\text{Er}^{3+}\text{-Yb}^{3+}$  and mixtures thereof.  
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61. A head-up display, comprising:  
a laminated transparency, comprising:  
a first transparent sheet having a first major surface  
and an opposite major surface defined as a second major  
25 surface;  
a second transparent sheet having a first major surface  
and an opposite major surface defined as a second major  
surface;  
an interlayer between and securing the first and second  
30 sheets to one another with the second major surfaces of the  
sheets facing one another, and  
at least one light emitting material having an absorption  
band on the first major surface of the first sheet or between the  
first major surfaces of the first and second sheets, and

a projection assembly having an electromagnetic radiation source, the projection assembly mounted in spaced relationship to the laminated transparency and configured to direct radiation of one or more selected wavelengths within the absorption band of the at least one light emitting material toward the first surface of the first sheet to impinge on the at least one light emitting material to cause selected portions of the at least one light emitting material to emit light.

62. The head-up display according to claim 61, wherein the light emitting material is selected from fluorescent materials, phosphorescent materials, and mixtures thereof.

63. The head-up display according to claim 62, wherein the absorption band is in at least the range of greater than 0 to less than 400 nanometers of the electromagnetic spectrum and the absorption band is greater than 400 nanometers of the electromagnetic spectrum.

64. The head-up display according to claim 61, wherein the light emitting material is a dye-doped dendrimer.

65. The head-up display according to claim 61 further including a sheet non-transparent to wavelengths within the predetermined absorption band between the at least one light emitting material and the first major surface of the second sheet.

66. The head-up display according to claim 65, wherein the laminated transparency is an automotive transparency.

67. The head-up display according to claim 66, wherein the electromagnetic radiation source of the projection assembly emits at least two radiation beams having a wavelength in the range of greater than 400 nanometers of the electromagnetic spectrum with at least one of the beams having a wavelength in the range of greater than 700 nanometers of the electromagnetic spectrum.

68. A head-up display, comprising:

a laminated transparency, comprising:

a first transparent sheet having a first major surface  
and an opposite major surface defined as a second major  
surface;

5 a second transparent sheet having a first major surface  
and an opposite major surface defined as a second major  
surface;

10 an interlayer between and securing the first and second  
sheets to one another with the second major surfaces of the  
sheets facing one another, and

at least one light emitting material capable of Up-Conversion of infrared  
energy into visible radiation defined as Up-Conversion material on the first major  
surface of the first sheet or between the first major surfaces of the first and second  
sheets, and

15 a projection assembly having an electromagnetic radiation source, the  
projection assembly mounted in spaced relationship to the laminated  
transparency and configured to direct radiation of one or more selected  
wavelengths within the absorption band of the at least one Up-Conversion  
material toward the first surface of the first sheet to impinge on the at least  
20 one Up-Conversion material to cause selected portions of the at least one  
Up-Conversion material to emit light.

69. The head-up display according to claim 68, wherein the  
Up-Conversion material is selected from fluorescent materials, phosphorescent  
25 materials, and mixtures thereof.

70. The head-up display according to claim 68, wherein the  
Up-Conversion material is a dye-doped dendrimer.

30 71. The head-up display according to claim 68, wherein the power  
source is capable of emitting at least two radiation beams wherein at least one of the  
beams is at a wavelength of greater than 700 nanometers of the electromagnetic  
spectrum.

72. The head-up display according to claim 68, wherein the laminated transparency is an automotive transparency.

5           73. A method of displaying images, comprising the steps of:  
selectively moving at least one beam of radiation of one or more  
selected wavelengths in a direction defined as a first direction toward a  
surface defined as a first surface of a light emitting material selected from  
materials having an absorption band, a material capable of Up-Conversion  
into visible radiation and mixtures thereof;  
10           displacing the radiation beam and the light emitting material relative to  
one another during the practice of the selectively moving step to selectively  
impinging at least one radiation beam having a wavelength in the  
electromagnetic spectrum on the light emitting material to cause the light  
emitting material to emit light having a predetermined configuration, while  
15           preventing transmission of radiation of wavelengths within the  
absorption band in a direction toward a surface defined as a second surface  
of the light emitting material wherein the first surface is opposite to the second  
surface.

20           74. The method according to claim 73, wherein the predetermined  
configuration includes images selected from alphanumerical images, dynamic  
images, moving figures, moving objects, stationary scenic views, moving scenic  
views, stationary objects, stationary persons and combinations thereof.

25           75. The method according to claim 74, wherein the wavelengths  
impinging on the light emitting material comprise wavelengths in the range of 300  
nanometers to 400 nanometers of the electromagnetic spectrum.

30           76. The method according to claim 74, wherein at least two  
wavelengths are impinging on the light emitting material in sequence with at least  
one of the wavelengths in the range of greater than 700 nanometers of the  
electromagnetic spectrum.

35           77. The method according to claim 73, wherein the images  
displayed are images of a head-up display system.

78. The method according to claim 73, wherein the selective moving step is practiced by selectively energizing and de-energizing the radiation source or by blocking and unblocking radiation from the radiation source and the  
5 displacing step is practiced by moving the beam along a plurality of scan paths to form adjacent light emitting and non-light emitting areas on the support.

79. The method according to claim 73, wherein the light emitting material is selected from fluorescent materials, phosphorescent materials, and  
10 mixtures thereof.

80. The method according to claim 73, wherein the light emitting material is a dye-doped dendrimer.